UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

ACADEMY FOR INFORMATION TECHNOLOGY

MODULE CSC1B10
Introduction to data structures (C++)
CAMPUS **APK**

NOVEMBER EXAMINATION

DATE: 2016-11-26 **SESSION: 08:30 – 12:00**

ASSESSOR(S) **DR DA COULTER**

INTERNAL MODERATOR **DR DT VAN DER HAAR**

DURATION 2 HOURS **MARKS 100**

SURNAME, INITIALS (or ID NUMBER): _____

STUDENT NUMBER: _____

CONTACT NR: _____

NUMBER OF PAGES: 5 PAGES

REQUIREMENTS: NON-PROGRAMMABLE CALCULATORS ARE PERMITTED

Q1	
Q2	
Q3	
Q4	
Total	

QUESTION 1

Draw the following in your answer book						
1.1	Use UML to model the following scenario: Intel, ARM, and SnapDragon are all kinds of processor. Every processor performs its `compute` operation differently according to its type. Each processor has an integer number of transistors and a string identifier as well as associated operations. A computer has a set of several processors to which it delegates its own `compute` operation.					(5)
Write the **most** correct option in your answer books						
1.2	Multiple inheritance may lead to the following problem:					
	A slicing	B diamond	C memory leak	D shallow copy	E null pointer	

1.3	Assuming that a Dog is-a Pet the following code shows which of the following problems?
	`Dog d;`
	`Pet p;`
	`p = d;`					

	A slicing	B diamond	C memory leak	D shallow copy	E null pointer	
1.4	It is best to use friend functions for operator overloading whenever possible.					
	True		False		無[1]	
1.5	Which of the following is an appropriate return type for **`operator`**<< ?					
	A `istream&`	B `ostream&`	C **`int`**`&`	D **`void`**`*`	E **`void`**`&`	
1.6	What is the correct return type for a constructor?					
	A **`void`**	B `nothing`	C `anything`	D **`char`**`*`	E **`void`**`*`	
Write your answers to the following in your answer books						
1.7	What is the difference between an object and a class?					(2)
1.8	A member function which sets part of an object's state is known as a(n) **(a)** while one which queries part of an object's state is known as a(n) **(b)**					(2)
1.9	Which techniques would be used to realize the following in C++ • Freeing resources such as memory • Deep copying when passing an object by value • Deep copying when setting one object equal to another					(3)
1.10	Name three principles of object oriented programming					(3)

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[1] The Sino-Japanese ideogram Wu/Mu in this case represents a question which is flawed.

QUESTION 2

Write your answers to the following in your answer books

2.1 Complete the following code. (10)

UJQueue.h

```
template <typename T>
class UJQueue
{
    public:
        UJQueue(); //No-args constructor

        void enqueue(T value); //Add an element to the back

        T dequeue(); //Remove element from the front

        bool isEmpty() const; //Query if list has values

        int length() const; //Get size
    private:
                (a)          list; //The stack has a list
};
(b)
#endif // UJQUEUE_H
```

UQueue.imp

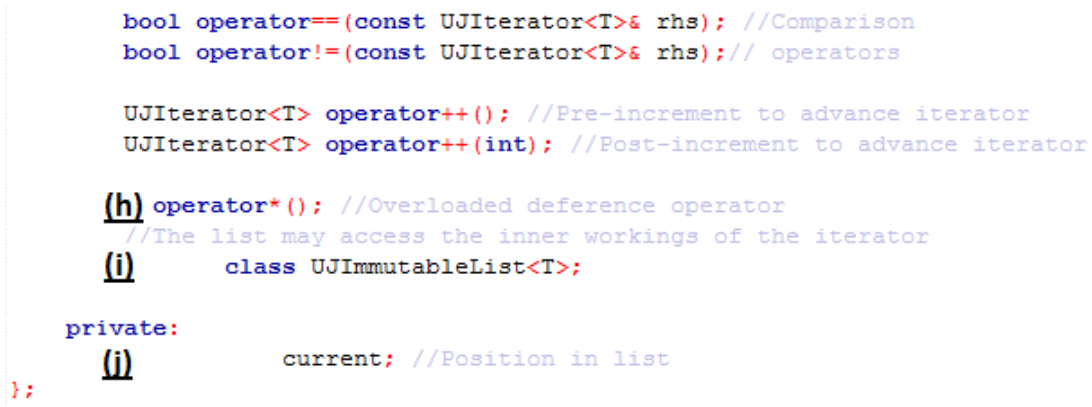
```
template <typename T>
void UJQueue<T>::enqueue(T value)
{
    list =      (c)      //Prepend value
}

template <typename T>
T UJQueue<T>::dequeue()
{
    T value = *(     (d)     ); //Get top value
    (e)   = -list; //Remove first value
    return (f)
}

template <typename T>
int UJQueue<T>::length() const
{
    return (g)            //Delegate to list
}
```

UJIterator.h

```
template <typename T>
class UJIterator //Provides access to elements in list
{
    public:
        UJIterator(); //No-args constructor
        UJIterator(UJNode<T>* node); //Copy constructor
```

		
2.2	Assume one wanted to print the contents of a singly linked list to the screen. Provide code which shows how that would be accomplished.	(5)
2.3	Which three operations are commonly referred to as the **big three.**	(3)
2.4	Describe how exception handling might be used to make the given classes safer. Explain each step.	(5)
2.5	Discuss two ways in which assertions are different from other error handling techniques	(2)
2.6	Draw a picture to illustrate what happens when a node is removed from the tail of a doubly linked list.	(5)

[30]

QUESTION 3

In your answer books please write the necessary C++ code for the following statements, and answer the remaining questions. Unless otherwise indicated you may assume that the necessary header files are included**. Most of the marks in this section are awarded for the file handling operations.**		
3.1	The text file `dept-health-data.txt` is made up of lines in the following format: `TestingStationName JAN FEB … DEC EOL` Where `TestingStationName` is a hyphenated word depicting a national disease centre station and the remainder of the line contains 12 real numbers indicating the ratio of false positive tests for each calendar month. EOL is the system's representation of the end of the line. Write code which shows how the annual average false positive rate can be calculated for each testing station. Please show code for the opening / closing of the file.	(5)
3.2	Define a structure with alignment packing/padding disabled to represent the data for one testing station. You may assume that the name of the testing station is at most 16 characters long and you must store the false positive data using a single variable.	(5)
3.3	Assume that the file dept-health-data.dat is a binary file of homogenous records of the type defined in question 3.2. Write code which calculates the total number of records within the file.	(5)
3.4	Describe five of the options for how a file stream may be opened and what the effects of using each of those options are.	(5)

3.5	```
	UJImage::~UJImage()
	{
	    for(unsigned int r = 0; r < dimensions.rows; r++)
	    {
	        delete [] pixels[r];
	    }
	    delete [] pixels;
	}
	``
	Analyse the above function asymptotically using Big-O notation. State any assumptions made.
		(10)

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QUESTION 4

In order to help in combatting crime you will need to assist the police service by writing a DLL (`ujimage-convert.dll`) which defines a function for helping them processing images from their security camera. Unfortunately the cameras only provide images in the `UJImage` format* and all of their experts only understand the ASCII PPM format. Your function will need to look as follows:

```
string toPPM(const UJImage& objImage);
```

**as discussed in class and most of the practical assignments this semester*

4.1	Write code for both the header file (5) and implementation file (5) for this DLL.	(10)
4.2	Write the set of command line instructions needed to compile and link this DLL including generating a `.a` file	(10)

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